

# **Western Center for Agricultural Health and Safety (WCAHS)**

*Protecting farmers, farmworkers,  
farm families and their communities*



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**Marc Schenker, MD, MPH, WCAHS Director  
University of California, Davis  
One Shields Avenue  
Davis, CA 95616**

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## SECTION I

### CENTER SUMMARY

Agriculture in the Western United States represents one of the most intensive and productive operations in the world. California's agricultural industry alone is the largest in the nation, producing nearly half of US-grown fruits, nuts and vegetables. In 2012, California's agricultural production was valued at \$44.7 billion and employed 36% of the nation's farmworkers. WCAHS' overall goals are: to develop and conduct solid transferrable research results, implement outreach/intervention programs (with a particular focus on vulnerable agricultural populations), evaluate agricultural injury costs, and maintain and create communications with regional growers, industry, labor, governmental and non-governmental organizations (NGOs) addressing agricultural safety and health. WCAHS at UC Davis is uniquely situated to address important current and emerging issues based on its strategic location in the heart of California's Central Valley and its co-location with UC Davis Schools of Medicine and Veterinary Medicine, the Colleges of Agricultural and Environmental Sciences, and Engineering. The multidisciplinary nature of the Center faculty has facilitated a wide variety of field-oriented research projects, along with diverse trainings and multi-lingual educational programs, and intervention schemes.

### RELEVANCE

Agriculture is one of the most hazardous occupations, and employs more than one million workers in the western states. WCAHS has direct public health importance by increasing the understanding of what causes disease in this population and applying the findings to develop interventions to reduce injury and illness in this population.

WCAHS maximizes the impact of NIOSH Center funding by obtaining extramural funding (e.g. NIH), nurturing existing partnerships (e.g. CalOSHA, CalEPA and Cal Department of Pesticide Regulations (DPR)) and building new NGO/private industry partnerships (e.g., Reiter Affiliated Companies, the largest multi-berry producer in the world). Partnerships and campus graduate student support continues to allow us to broaden our impact, enhance outreach and training activities and nurture the next generation of researchers. Substantial matching funding from UC Davis further allows us to leverage the core Center funding from NIOSH.

WCAHS continues to reach out and disseminate efforts through diverse traditional and new media outlets (e.g., webpage: <http://agcenter.ucdavis.edu>, quarterly newsletters, podcasts, multi-social media outlets that include a joint NIOSH 10-Ag Center Health & Safety YouTube channel, Facebook, etc.). The successes and outcomes of all Center activities are evaluated within our comprehensive evaluation program on an on-going basis.

## KEY PERSONNEL CONTACT INFORMATION

Marc Schenker, MD, MPH  
Director  
530-752-4050  
[mbschenker@ucdavis.edu](mailto:mbschenker@ucdavis.edu)

Kent Pinkerton, PhD  
Associate Director  
530-752-8334  
[kepinkerton@ucdavis.edu](mailto:kepinkerton@ucdavis.edu)

Stephen McCurdy, MD, MPH  
Director of Outreach  
530-752-8051  
[samccurdy@ucdavis.edu](mailto:samccurdy@ucdavis.edu)

Fadi Fathallah, PhD  
Director of Research  
(530) 752-1612  
[fathallah@ucdavis.edu](mailto:fathallah@ucdavis.edu)

Julie Rainwater, PhD  
Evaluation Program  
916-703-9189  
[julie.rainwater@ucdmc.ucdavis.edu](mailto:julie.rainwater@ucdmc.ucdavis.edu)

Cindy Valencia, MPH  
Center Manager  
530-752-5253  
[cvavelar@ucdavis.edu](mailto:cvavelar@ucdavis.edu)

## CENTER WEB LINK

<http://agcenter.ucdavis.edu>

## SECTION II

### PROGRAM HIGHLIGHTS

#### ADMINISTRATIVE CORE

The WCAHS Administrative Core provides the infrastructure, outreach/relationship building, and support for the Center's day-to-day functions (NIOSH grant and multiple sub-contracts' management, including convening the Administrative Committee, Steering Committee, External Advisory Board, and Strategic Planning retreat). Administrative Core management provides leadership input for NIOSH and NORA/AFF collaborative efforts, and guides WCAHS' three Administrative Core programs: outreach, pilot grants/feasibility, and evaluation. These are described in detail below.

#### ***Center-Wide Activities***

WCAHS continued convening stakeholders through Steering Committee, Executive Advisory Board and Strategic Planning meetings to keep stakeholders apprised and solicit input on future WCAHS projects. This year's annual Strategic Planning meeting brought together 35 stakeholders from various sectors, including: air quality, public health sciences, non-profits, CalOSHA, CalDPR and veterinary medicine.

Part of the retreat's purpose was to learn about potential new areas of research.



This year, two topics were discussed: 1) Valley Fever and Agriculture, and 2) Indigenous Farm Workers. Annual Strategic Planning retreats catalyze new ideas, which are subsequently evaluated by the Center and stakeholders as to their strength and alignment with WCAHS goals. It is a positive process that has generated many ideas that subsequently became projects funded by the WCAHS.

Dr. Antje Lauer, from CSU Bakersfield, and Gail Sondermeyer and Dr. Jason Wilken, from the California Department of Public Health, explained that the incidence of Valley Fever disease has dramatically increased in the western US over the past decade, yet little is known about the ecology of the fungus that causes Valley Fever or whether certain occupations are at increased risk for contracting the disease.

*Dr. Lauer, soil and Valley Fever specialist.*

Interpreters from Natividad Medical Foundation's **Indigenous Interpreting+** service explained that 50% of people migrating now from Mexico to do farm work in California speak an indigenous language, such as Mixteco, Zapoteco and Triqui. Many live in specific areas of California, such

as the Salinas Valley. Often speaking little or no Spanish, they have difficulty on the job and understanding basic social services like medicine.



WCAHS Director Marc Schenker, Indigenous Interpreting+ Director Victor Sosa, Natividad Medical Foundation President Linda Ford, Indigenous Interpreters Sergio Martinez and Angelica Isidro.

Strategic Planning retreat participants divided into two groups to further discuss and evaluate the topics of Valley Fever and indigenous languages, and how they can be addressed by WCAHS.



Valley Fever breakout group with (facing L to R) Gail Sondermeyer, Dr. Jason Wilken, and Dr. Antje Lauer.



Paul Verke (center), Assistant Director of Outreach and Public Engagement for the CalDPR, speaks with Indigenous Interpreter+ professionals, while Victor Sosa, Director of Indigenous Interpreter+, and Victor Duraj, UC Davis Biological & Agricultural Engineering, listen.

The retreat was a success thanks to the ongoing stakeholder interest and Ag Center support. A post-meeting evaluation survey found that 92% of participants found the retreat very valuable

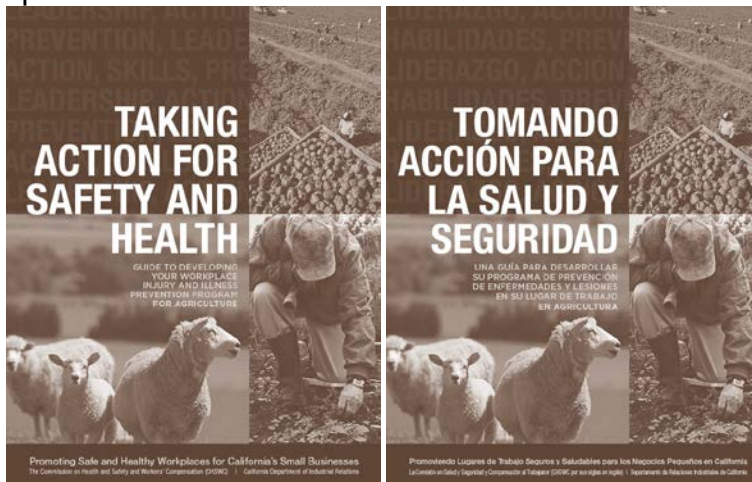
and 87% indicated that the WCAHS positively impacts their work in agricultural health and safety.

## ***Outreach Program***

The WCAHS outreach and education program continued strengthening relationships with stakeholders and working closely with the evaluation team to identify key outputs that could be translated for use by different stakeholders. The following are examples of other successful outreach programs:

- ***Worker Occupational Safety & Health Training & Educational Program (WOSHTEP) funded by the Commission of Health and Safety and Workers' Compensation***

Staff developed the “Taking Action for Safety and Health – a Guide to Developing your Workplace Injury and Illness Prevention Program in Agriculture,” available in English and Spanish.



- ***Heat Illness Prevention Education***

Staff conducted a series of workshops throughout California to assist farm managers, owners or staff in charge of safety to develop effective Heat Illness Prevention programs to comply with the CalOSHA standard (California Code of Regulations, Title 8, § 3395). Participants also received tips to conduct effective tailgate trainings and practiced their presentation skills using adult education methods. These trainings provide take-home materials in English, Spanish, Punjabi and Hmong. Forty-eight people attended the workshops and 127 attended brief presentations. In addition, some of the participating farmers granted research staff permission to conduct California Heat Illness Prevention (CHIP) research on their farms.

- ***Collaboration with all the NIOSH funded centers and WCAHS produced videos***

Staff created a YouTube channel (<https://www.youtube.com/user/USagCenters>), in partnership with the other 9 NIOSH funded centers. Over 48 videos have been uploaded to

the channel. We are currently finalizing five WCAHS produced videos to be submitted November 2014. Two of those videos are on pulmonary health and were made in collaboration with Drs. Kent Pinkerton and Keith Bein (Project 1). The videos explain how particulate matter is collected, analyzed, affects human health, and contributes to the development of asthma. Preventative measures to reduce the risk of asthma are discussed as well. These videos were showcased in an article entitled, “Surviving Summer with COPD” (see Appendix A for excerpts). Additional videos related to pesticide safety and econometrics are being developed.



- ***Western Agriculture Health and Safety Blog***

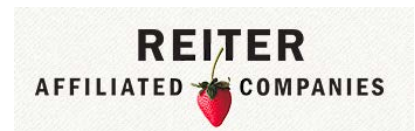
Staff started a safety blog dedicated to understanding and preventing illness and injury in western agriculture to increase the number of youth that we reach. The blog already has over 1,000 views. Go to <http://westernaghealthandsafety.wordpress.com/> to check out the blog.

- ***Strengthening collaboration with key stakeholders***

We have conducted awareness sessions, as requested, for diverse stakeholders/collaborators, such as farm labor contractors, growers, workers, the Mexican Consulate in Sacramento and others. Over 1000 individuals have received information on diverse health and safety topics, including pesticide safety, hazard identification and control, conducting effective tailgate trainings for workers, and heat illness prevention. Awareness sessions are conducted in English and Spanish.

- ***Designing a wellness program for farm workers***

The WCAHS partnership with Reiter Affiliated Companies (RAC) is still going strong. We received a 5-year grant from NIH to assess an intervention designed to reduce obesity and diabetes and increase health and wellness in RAC’s worker population.



## ***Pilot/Seed (Mini Grant) Program***

WCAHS supports graduate student education and training and assists in connecting students to agricultural health and safety careers. The NIOSH funded WCAHS Seed grant program seeks to encourage the development of creative research and translational, prevention/intervention training and outreach projects particularly by early-stage researchers interested in agricultural health and safety. The program is open to researchers in the WCAHS four-state region: Arizona, California, Hawaii, and Nevada. The WCAHS 5-year NIOSH grant allows for drawing down an additional \$650,000 in UC Davis institutional cost-sharing funds through the campus Administrative Coordinating Council of Deans (ACCD). Over the past year, 10 graduate students received support via these funds.

Four WCAHS Seed grants were awarded for grant year 2013 – 2014:

- 1) The effects of agricultural particles on pulmonary allergic responses: a focus on dendritic cells, Alejandro Castañeda, PhD Candidate, UC Davis;
- 2) Assessing clothing as a preventative method for heat illness in California's agricultural workers, Alondra Vega, PhD Candidate, UC Davis;
- 3) Evaluating inhalation exposure of biochar particulate matter and bound contaminants from agricultural associated dust, Sanjai Parikh, PhD, UC Davis; and
- 4) Heat exposure, dehydration, and kidney function in California's agricultural workers, Sally Moyce, PhD Candidate, UC Davis.

In addition, four Pilot grants were awarded:

- 1) Valley fever: the farmworker perspective, Carol Sipan, RN, MPH, PhD, UC Merced;
- 2) Occupational health and safety awareness and education for Latino immigrants, Xóchitl Castañeda, PhD, UC Berkeley;
- 3) Developing the next generation of ag safety and health leaders, Benjamin Swan, PhD, Cal Poly San Luis Obispo; and
- 4) Assessment of Arizona Agriculture Health Data, Phillip Harber, MD, University of Arizona. See Appendix B for a summary of the projects.

## ***Evaluation Program***

WCAHS continues to work with Dr. Julie Rainwater and her evaluation team to assess the impact of WCAHS research, interventions and outreach. The following are examples of specific evaluation efforts:

- ***WCAHS Stakeholders***

The Evaluation Program presented findings from the 2013 survey at the 2014 Annual Strategic Planning retreat. The survey asks stakeholders to rate the value of WCAHS and its products and solicits perceptions of the center's influence on stakeholders' understanding of agricultural health and safety issues. Responses (n=35) were overwhelmingly positive; 86% of respondents agreed or strongly agreed with the statement, "Provides opportunities to meet others interested in agricultural health and safety with whom I could potentially collaborate,"— an important objective of WCAHS. Of those who had used products of the WCAHS, at least half described each item as either "valuable" or "extremely valuable" by rating them a 4 or a 5 on a 5-point scale. Outreach and training rated highest with 100% of outreach users (n=14) and 92% of training users (n=13) rating the respective services a 4 or 5. While WCAHS videos and policy papers were not as widely used, 75% (n=6) of those who had utilized the products found them "valuable" or "extremely valuable." The WCAHS website rated lowest, with only 57% of users (n=8) rating the product a 4 or 5.

- ***Project Evaluation***

The evaluation team meets annually with WCAHS investigators to review program-specific logic models and document activity, outputs and outcomes of the center projects. Following the meeting, project investigators enter data on activities and outcomes into a database managed by the evaluation team.

- ***Evaluation of WCAHS Outreach and Translation***

The evaluation team met with outreach leaders Dr. Xóchitl Castañeda and Teresa Andrews to identify appropriate and feasible evaluation methods to assess the impact of four translation products: 1) a promotoras training conference, 2) an online resources repository, 3) an occupational health and safety campaign for binational health week, and 4) an online agricultural health and safety resources repository. The team also contributes expertise for evaluation of the YouTube site and reviews web trends data.

- ***Presentation Materials***

The WCAHS evaluation team continued to update and refine materials describing the Center's impact on agricultural risk, costs, and impact. New material on the WCAHS summary document features accomplishments of the Center in the areas of heat illness prevention, respiratory disease, ergonomic solutions, pesticide exposures and outreach.

- ***Developing Cross-Center Collaborations for Evaluation***

As a member of the NIOSH AFF initiative-wide evaluation workgroup, Evaluators, Coordinators, and Outreach personnel (ECO), the WCAHS Evaluation Program played a leading role in producing several cross-center products, including a repository of compelling outcomes from the NIOSH Ag Centers, available on a Dropbox site. Each of the 10 NIOSH Ag Centers contributed documents to the repository, and these documents were filed and indexed by Center and by research topic. The repository provides evaluators from all participating Ag Centers with access to cross-center program information, best practices, and relevant statistics and research for agricultural health and safety.

## **RESEARCH PROJECTS**

### ***Project 1: Effects of California agricultural particulate matter in a murine intranasal sensitization model of allergic airway inflammation***

PI Kent Pinkerton, PhD; Co-I Keith Bein, PhD

#### ***Challenges***

- Assess the relative toxicity of size-segregated particulate matter (PM) in California's Central Valley.

- Establish the most scientifically sound methods for (i) extracting PM from the collection substrates prior to toxicological testing, (ii) administering the extracted PM doses during exposure studies, and (iii) chemically characterizing the PM exposures.

### Impacts

- Toxicity screening of size-segregated PM common to California's Central Valley will lead to more targeted and effective strategies for regulating air quality to improve human health.
- We will better understand the relative risk of asthma development in the agricultural setting.



### Milestones

- Completed an intensive study evaluating PM from the ambient atmosphere in Fresno, CA, a large Central Valley city surrounded by agriculture and with high air pollution. The purpose was to find out if season, size of PM, and/or time of day differentially affected the toxicity of PM. This was evaluated using a mouse bioassay. Vehicular emissions, the regional background PM mixture – which is dominated by agricultural emissions – and residential and commercial cooking emissions were found to significantly cause inflammatory responses depending on PM size and the season. These results were presented at numerous professional conferences, media interviews and webinars and are currently being finalized for submission to the journal *Environmental Health Perspectives*.
- PM collected during the day near Fresno was found to significantly increase pulmonary total cellular inflammation compared to nighttime PM and exacerbate allergic airway inflammation following allergen challenge. These results will be published in the *Journal of Toxicology and Environmental Health*.
- Improved our techniques for extracting PM from collection substrates because the extraction method critically influences the biological responses observed following administration to the respiratory tract, with some responses being larger for different extraction approaches. These data are currently under peer review for publication in *Toxicological Sciences*.
- Established a model of adult-onset asthma in female mice aged 9 months compared to 3 months of age old. This model will allow us to study adult-onset asthma, which is prevalent in the Central Valley of California.
- Designed, implemented and completed a large-scale field study that collected PM from an agricultural setting at the Kearney Agricultural Research and Extension (KARE) Center in Parlier, CA. Different sizes of PM were collected at different times of day corresponding to (i) the nocturnal inversion (00:00-06:00), (ii) breaking of the nocturnal inversion (06:00-12:00), (iii) development of the mixed layer and peak actinic flux (12:00-18:00) and (iv) formation of the nocturnal inversion and residual layer (18:00-24:00). The collected PM samples are currently in the process of being extracted for subsequent toxicological testing. The air quality measurements

are currently being analyzed to provide a characterization of the sampling protocols and air quality dynamics in the Central Valley.

## ***Project 2: Using large national datasets (NAWS) and econometrics in agricultural injury research***

PI J. Paul Leigh, PhD

### ***Challenges***

- Estimating differences between documented and undocumented farm worker households participating in the federal Women, Infants and Children (WIC) program as well as the Supplemental Nutrition Assistance Program (SNAP) from the National Agricultural Workers Survey (NAWS). Explaining why these differences occur in the data using reasoning from an understanding of the design of the NAWS, legal requirements for WIC and SNAP, and economic and sociological theory.

### ***Impacts***

- Analysis of data from the Bureau of Labor Statistics' Survey of Occupational Injury and Illness (BLS-SOII) found that the US government undercounts the number of injuries and illnesses on farms by nearly 80%. Agriculture could be an even more powerful economic force if we accurately counted and addressed the causes of harm to agricultural workers and families. This research was picked-up by the media. Click here to access the full article on NPR:  
<http://www.npr.org/blogs/thesalt/2014/05/08/310724952/injuries-on-the-farm-happen-much-more-often-than-were-told>.



### ***Milestones***

- Medical Expenditure Panel Survey (MEPS) and the Health and Retirement Survey (HRS) data are being examined in order to estimate disparities and time-trends in disparities between agriculture and all other industries for insurance coverage and physical functioning of persons employed in those industries.
- Preliminary results show that undocumented households participate in WIC at almost the same rate as documented households. This was not surprising given that WIC allows undocumented persons to receive benefits. Undocumented households with 2+ children were more likely to participate than documented households.
- Preliminary results show that undocumented households participate in SNAP at roughly one-third rate as documented households. This was not surprising because SNAP only allows pregnant mothers and children born on US soil to qualify for benefits.
- Work continued to assess predictors of which groups of farm workers (e.g., documented vs undocumented) are covered by insurance, access medical care, report barriers to care, work for contractors and work excessive hours. Data will be drawn from the NAWS.

- Work has begun on Medicaid participation by documented and undocumented farm workers. Initial results show that undocumented households participate at about half the rate of documented households and that, again, the undocumented were more likely to increase their participation with greater numbers of children in the household. The paper describing this analysis has been submitted to the *Journal of Occupational and Environmental Medicine*, and is expected to be accepted for publication in November, 2014.

### ***Project 3: Impacts on new caging laws in California on worker health & safety in layer hen facilities***

PI Jerold Last, PhD

#### ***Challenges***

- Determine the effect on exposure of workers to toxic air pollutants upon housing layer hens in unconventional facilities required to achieve compliance with the new caging laws in California (and elsewhere).
- Evaluate effects on workers of worker exposure in unconventional facilities required to achieve compliance with the new caging laws in California (and elsewhere).
- Evaluate the toxicity of PM contained in ambient air being inhaled by workers in the San Joaquin Valley in the course of their normal workdays.



#### ***Milestones***

- Research on the relative toxicity of PM from layer hen barns with different types of caging (Challenge #1) is completed.
- Research focusing on the effects on workers exposed to PM in unconventional facilities required to achieve compliance with the new caging laws in California (Challenge #2) has proven impossible to accomplish. The industry in California and elsewhere that is attempting to comply with the new caging rules is using hybrid facilities featuring all of the different types of caging. The systems are efficient enough that small numbers of workers rotate through barns containing the different types of caging on a routine basis, thereby precluding comparative studies of workers in the different barns with a specific type of caging.
- A collaboration with Project #1 to perform toxicological studies of coarse PM collected from ambient air at the Parlier site to determine the toxicity of these particles (Challenge #3), and ultimately which components of the PM are responsible for the observed toxicity.
- To accomplish Challenge #3, procedures to perform quantitative analyses of lung toxicity with purified PM preparations will be first be optimized. This will lead to consensus on how to proceed

where Projects #1 and #3 have used different techniques in the past to study toxicity of PM administered to mice. The first set of experiments compared the efficacy of the same dose of PM administered to mice by the intranasal and intratracheal routes. A jointly authored manuscript is in preparation reporting the results, and should be submitted for publication in 2014. The next two sets of experiments in this series will address determination of the optimal ways to collect the size-fractionated PM for toxicological studies and the optimal ways to elute PM from the substrates on which they are collected.

## **PREVENTION/INTERVENTION PROJECTS**

### ***Project 4: Rapid assays for human and environmental exposure assessment***

PI Bruce D. Hammock, PhD

#### ***Challenges***

- The overall goal is to develop improved tools to detect pesticides in farm- and landscape-workers and to apply these tools to examine exposure levels.

#### ***Impacts***

- Immunoassays have been used in medicine for more than 50 years to help physicians determine the state of a person's health. Completion of this study will provide companies an improvement to immunoassays that could increase the shelf life of products, reduce production costs and allow the immunoassays to be made available in developing countries where refrigeration is not optimal. The result of the research gives scientists an improved method to make antibodies for chemical targets.
- Once complete, the exposure studies will contribute to the body of knowledge that will provide guidance to educators to inform the participant population about pesticide use and how to avoid or minimize exposures. It will inform regulators to develop or modify pesticide use in occupational settings.



#### ***Milestones***

- The project has developed a highly sensitive assay for 2,4-D, having a limit of detection of about 0.1 ng/mL. Characterization and validation studies are underway.
- Paclobutrazol is a new triazole herbicide. A monoclonal antibody-based ELISA was developed for the analysis of paclobutrazol residues in wheat kernel. An assay was also developed for the

glycosylated dihydrochalcones (Ranganathan et al., 2013). These are the first reported immunoassays for these compounds.

- The feasibility of using a urinary dipstick assay to detect the herbicide atrazine mercapturate at relevant exposure levels has been tested.
- The final recruitment and sample collection protocols have been completed for California studies to begin studying pesticide exposure in farmworkers and landscape workers.
- The exposure study based with collaborator, Dr. Qing Li at the University of Hawaii, is in the early stages of communication with the community. Discussions have been conducted with the Hawaii State Department of Agriculture, Kauai County Economic Development Department, Hawaii Farm Bureau, commercial agricultural industries (e.g. Syngenta, Pioneer, Monsanto), all of which express concern about pesticide exposures in the bird chaser population. Dr. Li completed a study in which ambient air samples were taken in and around a middle school in Waimea Canyon Kauai that helped determine target pesticides for the worker exposure study. Restricted use pesticides sales records from 2010 - 2011 were used to compile a list of 24 pesticides currently used in the subject area, including chlorpyrifos, metolachlor, bifenthrin, benzene hexachlorides (BHCs) and dichlorodiphenyltrichloroethanes (DDTs).

### ***Project 5: Reducing the risk of heat-related illness in western agricultural workers***

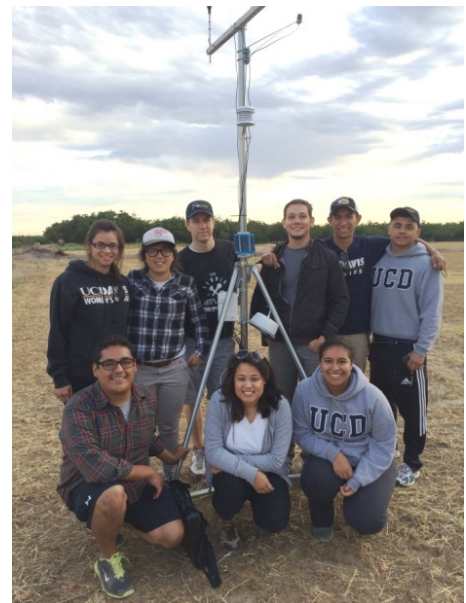
PI Marc B. Schenker, MD, MPH

#### ***Challenge***

- Advance the understanding of the physiological responses to increased environmental heat and physical exertion among farm workers through the analysis of personal characteristics, monitors and sensors.

#### ***Impacts***

- Focus groups conducted by the California Institute for Rural Studies (CIRS) revealed that farmworkers prefer heat illness education to be participatory and delivered orally over all other formats. Oral presentations will be developed for improved trainings.
- Physiological data collected will assist in developing heat illness risk estimates for farmworkers, improving on old physiological data that were derived from intense, short term work periods (e.g. firemen, athletes, military personnel) that are in current use.



## Milestones

- One hundred workers were assessed between late June and August 2012, on seven different farms in the California Central Valley. Preliminary analyses suggest that despite drinking a median volume of 96.5 oz of liquids, of which 68 oz was water, over 20% lost over 1.5% of their original body weight (ACGIH suggested criteria of increased risk of dehydration), approximately four fifths exhibited increased serum osmolality, with about a fifth experiencing at least a 3% increase. These are preliminary data and analysis of these data is continuing.
- Data analysis progresses on the 354 study members who worked in farm labor tasks in the last year before they were interviewed. Preliminary analyses suggest that approximately forty percent of the workers (but over half of the females) had experienced at least one symptom of heat related illness, the most common symptoms in decreasing order were: dizziness, nausea and muscle cramps. The results will be discussed in future focus groups and summer field studies in 2014 and 2015.
- The summer 2014 field data collection is ongoing and will be completed October 3<sup>rd</sup>, 2014. Over 80 workers were monitored as specified in the experimental plan for this year. Additional measures conducted this season have been :
  - The inclusion of accelerometers to better characterize periods of rest and work.
  - A more detailed and refined accounting of workers apparel and surface body temperature using infra-red technology.
  - An assessment on the kidney health of male workers to determine whether, in this population of immigrant workers, there is evidence of kidney disease associated with working in high heat.

## Project 6: Effects of ladder rung spacing on agricultural workers

PI Fadi Fathallah, PhD

### Challenges

- The ladder rung spacing project is a multi-year effort to model and develop an optimized ladder design to reduce falls in agricultural orchard work. The overall work includes theoretical modeling, laboratory testing and validation, and subsequently testing and validation work in the production agriculture environment. Developing relationships with the ladder and orchard industries is an important element.



**Impacts**

- Potential to decrease ladder related injuries related to agricultural work and increase worker comfort and efficiency.

**Milestones**

- Continued work with computerized model development using the AnyBody musculoskeletal Modeling System, including incorporation of ladder systems through Solid Works 3D solid modeling integration. Further trials with electromyography and lumbar motion exoskeleton-derived analysis data. Obtained low-cost miniature motion capture system, YEI 3-Space Sensor, to be used for joint motion assessment. A full-17 sensor system will be obtained this coming year to facilitate full-body motion analysis
- Built adjustable-rung ladder apparatus to facilitate the configuration of ladders with desired specific rung spacing (e.g., 11.5 inch). This ladder will be used in laboratory evaluation that matches subject's anthropometry with specific ladder rung spacing.
- Continued relations with industry partners including fruit growers and ladder manufacturers. Reached out to eight Farm Advisors who had previously worked with the UC Ag Ergonomics Research Center and others in orchards to discuss trends in the use of orchard ladders. Several advisors noticed the increase in olive trees planting in vineyards, with increased use of orchard ladders, which raised concerns by some in the vineyard industry that the introduction of ladders brings a new and real risk to their workers. This will expand the outreach of the project beyond typical orchards.
- Outreach has occurred effectively in several ways. A series of NIOSH Ag Center YouTube videos on ladders safety in general and this ladders project in particular were developed and will be posted soon. A "blog" contribution was also posted to describe the current project and its implications to orchard workers. Short presentations on the ladders project continue to be made during frequent tours of the Heidrick Western Center for Agricultural Equipment, where this ladders project is based on the UC Davis campus.
- Gave a demonstration of ergonomic tools and approaches, including alternative ladder designs, at the 2013 North American Agricultural Safety Summit, Minneapolis, MN.
- Initiated conversations with Cal/OSHA Enforcement and CalOSHA Standards Board engineering leadership, informing them about the importance of the project and its potential implications to future standards and guidelines.

## APPENDIX A – “Surviving summer with COPD”

Summer days of high heat and poor air quality that are hard on healthy lungs can be extremely challenging for those with reduced breathing capacity due to COPD, or chronic obstructive pulmonary disease. Combined with the drought and the likelihood of increased fires, COPD patients need to take extra precautions to protect their lungs during July and August.

UC Davis pulmonary and air quality specialists encourage COPD patients to check the daily air quality index (AQI) in their local newspapers or on the Sacramento Metropolitan Air Quality Management District’s Spare the Air website: <http://www.sparetheair.com>.

“The AQI is a prediction of pollutants in the atmosphere we breathe,” said Anthony Wexler, professor of engineering and director of the UC Davis Air Quality Research Center. “It’s based on what is known about the next day’s weather combined with assumptions about activities that increase ozone and particulates.”

While wildfires intermittently increase particulate matter in the air, ozone is a daily concern during summer, Wexler explained. It is created by gases caused by emissions from, for instance, factories, outdoor grills and cars that create a layer of air pollution close to the ground. Increased sunlight and heat put ozone formation into overdrive.

“There’s a lot more chemistry happening close to the Earth’s surface during summer that is linked with inflammation, which plays a big role in COPD progression,” said Kent Pinkerton, a pulmonary health specialist and director of the UC Davis Center for Health and the Environment. “It’s not just recommended, it’s essential to be cautious.”

When the AQI climbs over 100, Karina Berge, a UC Davis nurse and pulmonary rehabilitation program coordinator, gets in touch with COPD patients to reschedule appointments and remind them to stay indoors.

“If they don’t have air conditioning at home, I suggest they go to the mall or a friend’s house that does,” said Berge.

Because it’s important for COPD patients to maintain their pulmonary rehabilitation programs — which include exercise therapy — Berge advises patients to do light exercises at home with resistance bands. She also reminds them to:

- Stay hydrated
- Plan outdoor activities during mornings or evenings
- Remember to take medication, including rescue medication in the early stages of exacerbations
- Page the on-call pulmonary therapist at 916-816-COPD if they have questions or may need hospitalization

Berge encourages family members and friends to check in on those they know with COPD during times of high heat, because interaction can help relieve the isolation of being house-bound.

“A little conversation can be the greatest medicine,” said Berge.

**Also included in the article was the following information for helping the reader understand how air pollution is measured:**

#### **What is the AQI?**

The air quality index is used by government agencies to communicate predictions of levels of ozone and particulates in the atmosphere on a scale of 0 to 500. Those with diseases that limit lung capacity, such as COPD, need to take extra precautions when the AQI reaches 101.

1.	0-50	2.	Good
3.	51-100	4.	Moderate
5.	101-150	6.	Unhealthy for sensitive groups
7.	151 to 200	8.	Unhealthy
9.	201 to 300	10.	Very unhealthy

UC Davis Health System News Article, [https://secure.ucdmc.ucdavis.edu/welcome/features/2014-2015/07/20140717\\_summer-copd.html](https://secure.ucdmc.ucdavis.edu/welcome/features/2014-2015/07/20140717_summer-copd.html), Accessed Oct. 7, 2014

## APPENDIX B – Pilot/Seed Projects Detailed Descriptions

### **Seed Project 1 – The effects of agricultural particles on pulmonary allergic responses: a focus on dendritic cells**

Alejandro Castañeda, PhD Candidate, UC Davis

The San Joaquin Valley has one of the highest incidences of asthma in the country, a phenomenon that is related to the high levels of ambient particulate matter generated through anthropogenic processes such as agriculture farming and vehicular transportation emissions. The purpose of this study is to understand how agricultural particulate matter exacerbates asthma through the use of an animal model. Specifically, through the use of in-vitro cell culture systems we are interested in addressing the molecular mechanisms through which agricultural particles enhance the activation of immune cells that involved in asthma. The aims of this study are to 1) validate an animal model in which agricultural particulate matter exacerbates the pulmonary allergic immune response in house dust mite, 2) analyze dendritic antigen presenting cell (APC) activation markers up regulated by agricultural particulate matter and 3) assess the mechanisms of APC activation by particulate matter.

Eight week old BALB/c mice were exposed to PBS, Sacramento ambient particulate matter (PM, 2.5 $\mu$ m), house dust mite (HDM), or HDM+PM (n=4 for all groups). Lung tissue, bronchoalveolar lavage (BAL) and plasma were analyzed for extent of inflammation. Gene expression was analyzed by quantitative polymerase chain reaction using lung homogenate. To assess APC activation by PM, the human U937-monocyte cell line was used to generate macrophages. Macrophages were treated with 10 $\mu$ g, 50 $\mu$ g, or 100 $\mu$ g of PM as well as ovalbumin (OVA) and OVA+PM to assess their activation and extent of pro-inflammatory gene expression. Administration of PM during allergen sensitization to HDM lead to a significant increase in airway inflammation as assessed through BAL total cells, compared to mice treated with HDM only. Histopathological analysis of lung tissue supported these findings. Gene expression analysis of the lung indicate that pro-inflammatory markers IL-6, TNF $\alpha$ , CXCL5, and CYP1A1 were elevated in HDM and HDM+PM groups. Additionally, the APC/dendritic cell markers CD80, CD86, MHC Class II, and CD11c were also elevated in HDM and HDM+PM treatment groups. Cell culture experiments demonstrated that macrophage cells treated with increasing levels of PM produced a dose-response curve in relation to the markers: TNF $\alpha$ , CXCL3, IL-6, IL-1b, HO-1, and CYP1A1. Cells treated with both OVA+PM showed synergistic increases in the pro-inflammatory markers CXCL3 and IL-1b.

Our findings suggest agricultural particulate matter enhances the inflammatory response to allergens in the lung by significantly enhancing the influx of immune cells that enter the lung. Markers of antigen presenting cells, including dendritic cells, are enhanced by particulate matter

treatment suggesting particles may enhance activation of dendritic cells facilitating their ability to encode immunological memory against allergens. Additionally, cell culture experiments using macrophage cell lines indicate that particulate matter also leads to the activation of these cells and secretion of pro-inflammatory mediators (TNF $\alpha$  and IL-6) that further attract immune cells into the lung, specifically neutrophils. This is in line with the observed effects in our animal model, as both TNF $\alpha$  and IL-6 were enhanced by HDM and HDM+PM treatment. Finally, the significant increase in hemeoxygenase-1 in PM-treated macrophages suggest oxidative stress may be another potential mechanism driving the inflammatory response.

To date Aim 1 has been completed, as our animal model suggestion particulate matter enhances pulmonary allergic responses. We are in the final stages of completing Aim 2 which is to assess markers of cell activation in macrophages and dendritic cells; this aim will be completed in mid to late October. Aim 3 is expected to be completed by December.

### **Seed Project 2 – Assessing clothing as a preventative method for heat illness in California’s agricultural workers**

Deborah Bennett, PhD; Alondra Vega, PhD Candidate; Uwe Reischl, PhD, MD, UC Davis

The SEED grant supported preparations and data collection in the summer of 2014 to achieve project aims. The study aims to: 1) determine the optimal clothing scheme for agricultural laborers when working in varying conditions of extreme heat; 2) validate Dr. Budimir Mijovic’s methods in agricultural laborers working in the fields and 3) determine the effects of wearing multiple layers of clothing when working in varying conditions of extreme heat.

The camera protocol was written and reviewed by peers in the Center for Health and the Environment. The effectiveness of the camera was tested among study partners, so that it could be ready to go out into the fields in late June. A copper sheet was purchased, so that it could serve as a temperature reference point for the infrared pictures out in the fields. This was done because the temperatures of the days vary and we wanted to be able to compare the pictures by having a point of reference. As of mid-June, the questionnaire was completed and approved by the IRB. We began collecting data all throughout California beginning in late June and will continue to do so until the first week of October. To date, we have 200 participants with IR pictures and 250 participants who have completed clothing questionnaires.

## **Seed Project 3 – Evaluating inhalation exposure of biochar particulate matter and bound contaminants from agricultural associated dust**

Sanjai Parikh, PhD, UC Davis

### ***Challenge:***

- Asses the occupational hazards associated with biochar particulate matter (PM) inhalation by farm workers and local residents. Conduct simulated dust generation experiments to evaluate the potential for transfer of toxic chemicals from biochar to humans via a series of with both chemical and biological analysis of collected dust fractions.

### ***Impacts:***

- Results from this study demonstrate that guidelines for the management of biochar amended agricultural fields can be established through recommendations of irrigation practices based on soil texture, with only minor considerations for the specific biochars used.

### ***Milestones:***

- Completed dust generation trials to examine effect of 1) soil texture; 2) biochar types; and 3) biochar application rate using silt loam and sandy loam soils and various biochars (900° C walnut shell; 500, 700, 900° C pine wood) at 1, 2, and 5% biochar application rates with varied moisture contents.
- Demonstrated that soil texture is the key factor in dust particle size distribution, with fine textured soils producing finer dust than courser soils. In contrast, biochar type, biochar application rate and irrigation rate, do not have a big influence on the dust size. Found that increasing irrigation amount leads to larger dust size percent, indicating that aggregates could have been formed.
- Determined that soils amended by biochars can reduce PM<sub>10</sub> emission, and this phenomenon becomes obvious when irrigation is intense, indicating formation of aggregates.
- Determined that soils amended by high biochar application rate (5% biochar) at low irrigation rate generate the most dust, posing the most potential hazards among all the treatments. Initiated bioassay and chemical analysis of dust samples to evaluate toxicity of biochar-dust mixtures.

## **Seed Project 4 – Heat exposure, dehydration, and kidney function in California's agricultural workers**

Sally Moyce, PhD Candidate, UC Davis

Seed grant funds were used to fund a field staff worker to collect data on kidney function and diabetes in California's agricultural workers from July to October. The project collected data from 149 male participants working in conditions of high ambient temperatures throughout the Central Valley. We measured changes in serum creatinine, urinary micro-albumin levels, and hemoglobin A1c and plan to assess the relationship between heat exposure and kidney insufficiency in male workers. At this point, it is too early to present any of the data, but we expect early reports of prevalence of kidney insufficiency to come in mid-October.

A presentation of the study and some of its potential impacts will be presented at the Center for Occupational and Environmental Health gathering in mid-October.

Once we have analyzed the data, abstracts will be sent to various conferences and publications to disseminate the information. Results from this study will help inform heat illness policy and help to develop educational interventions for agricultural workers in order to protect kidney health and prevent future damage.

## **Pilot – Valley fever: the farmworker perspective**

Carol Sipan, RN, MPH, PhD, UC Merced

Forty persons with a history of Valley Fever acquired while employed in outdoor agricultural work will be interviewed using a mixed methods approach pending Institutional Review Board (IRB) approval expected later this month. Data collection materials and participant incentives for the study have been purchased. The relationship with the agricultural community organization, *Líderes Campesinas*, has been established by the PI and graduate RA for recruitment. The interview has been pilot tested and revised based on feedback. The IRB application is under review at UC Merced. Data collection will be completed during the first part of November.

## **Pilot – Occupational health and safety awareness and education for Latino immigrants**

Xóchitl Castañeda, PhD, UC Berkeley

### **Overview**

The overall goal of this project is to build a healthier and better informed agricultural worker community in the U.S. The objectives are to reduce occupational health and safety issues and to promote healthy life styles among Hispanic agricultural workers and their families. During this

third phase of the project, the Health Initiative of the Americas (HIA) did the following to achieve these goals and accomplish these objectives:

- Asset mapping of existing resources of UC Berkeley's Labor Occupational Health Program (LOHP) and UC Davis' Western Center for Agricultural Health and Safety (WCAHS) to select the best materials to use for training and educational sessions;
- Development of a work plan with partners to define roles and leverage resources, events, and venues for conducting activities;
- Implement activities and evaluation mechanisms of events and activities: webinar training, Binational *Promotoras* Conference, and *Ventanilla de Salud* staff trainings.

### ***Asset Mapping***

The goal of the Asset Mapping of existing resources was to find adequate and relevant material that could be used for the training and technical assistance interventions. An excel file was created to serve as a template for the structure and format in which they would be incorporated into the "Occupational Health and Safety," virtual resource center. The data in the excel file is separated according to five key areas; Farm Worker's Rights, Injuries, Heat Illness, Respiratory Illness, and Pesticides.

There are specific guidelines that were followed when looking for resources. Each resource has to be in Spanish, accessible to view, applicable to current times, related to the five key areas mentioned above, and appropriate for training purposes. In this Excel file, each resource is listed under its corresponding key area and includes: a short description of its format and objective, the title, a direct link of where it can be found, the author, and the associated organization and website.

The primary methods for acquiring the accumulated data were online research and written requests sent by email to experts in the field. The online research has been a process of accumulation and asset mapping. LOHP and WCAHS were the starting points of the online research because they are readily known to have reliable and culturally competent information. Existing resources found, however, were not limited to these websites, and include other websites, repositories, and guides. As information was gathered and organized into the Excel file, there was a snowball effect where one source led to another and so forth. Over 200 resources were reviewed; from these close to 100 sources were inputted into the Excel spreadsheet. The new resources have been added to the Online Resource Center (created during Phase 1).

### ***Development of a Work Plan with Partners***

HIA contacted its partners who would benefit from this training, which included the consular networks, Binational Health Week (BHW) task forces, *promotoras* (community health outreach workers), and community leaders. The partners were invited to one (or more) of the training activities that best suited their needs and schedules.

### ***Implementation of activities***

A webinar was given on July 31 for the Binational Health Week task forces, which included the consular networks, to “Train the Trainers” on the five health topics (Farm Worker's Rights, Injuries, Heat Illness, Respiratory Illness, and Pesticides) and the Occupational Health and Safety resources they would use in their own communities, agencies, and networks. They were provided with the list of resources from the asset mapping and the Promotoras Manual on Occupational Health and Safety that was produced in phase one of the project. Electronic links were also provided to facilitate sharing on social networking sites. One hundred and thirty three consulates attended this webinar, including the coordinators of an additional one hundred and seventy eight local BHW task forces nationwide.

The Binational *Promotores* Conference took place on September 9, 2014 at the California Endowment in Oakland, California. More than two hundred (200) *promotores* from five U.S. states attended this wonderful event. Eighteen participants travelled from the Mexican state of Zacatecas as part of the Binational *Promotoras* Exchange program, including nursing and nutrition students and *promotoras* volunteers from the Mexican Institute of Social Security and the Ministry of Health of Zacatecas. Attendees represented diverse institutions such as the Tiburcio Vazquez Health Center, Escuela Popular, *La Clínica de la Raza*, Petaluma Health Center, Planned Parenthood of Northern California, Join Together Nevada, *Asociación Mayab*, The Center for Families, Yolo Family Resource Center, LOHP, and WCAHS. A special workshop was devoted to training for this project, titled Occupational Health and Accident Prevention in Farmworkers. Over 100 of the participants attended this special session which was led by Dinorah Barton-Antonio, Program Coordinator from LOHP.

Lastly, four key staff from the *Ventanilla de Salud* (VDS) of the San Jose and Sacramento consulates received this training as well. It was fortunate that they were able to attend the July 31 webinar along with their community affairs consul who handles Binational Health Week. VDS staff are able to utilize the knowledge gained from this in-depth training directly with the target population when assisting the agricultural workers who come to their consulates in need of health information and referrals.

### **Pilot – Developing the Next Generation of Ag Safety and Health Leaders**

Benjamin Swan, PhD, Cal Poly San Luis Obispo

Providing a skilled workforce for the California agriculture industry that is safety and health conscious is a goal for all agricultural educators as they train and prepare their students for employment. This study looked specifically at secondary agriculture teachers in the San Joaquin Region to see what extent they were trained to teach safety and health topics and to what extent they train their students in those same safety and health topics. Safety and health topics were within the following areas: Overall Agricultural Safety & Health, Farm Buildings, Crop Storage, Chemical Storage, Tractor Safety, Equipment and Machinery, and Livestock Facilities. The seven areas were comprised of 97 items, and 26 items surfaced as needing immediate attention. It was also noted that the lowest trained area was in communicating in Spanish which applies to

all of the safety and health topics. This will be a focus area as this pilot project moves forward and eventually to the state and region. In regards to training preferences, the teachers indicated they would prefer June and/or July in the Fresno, Hanford, and/or Visalia area(s) in half-day to 2 full day increments. In general, the teachers feel their administrator will strongly support their participation in the training. In addition, the teachers will be offered professional development credit to attend and then implement the training throughout their facilities and with their students. An online agricultural safety and health certification will be developed for the students to verify their knowledge. This will allow the researcher to track the efforts of teachers and students at the grass roots level.

Data was collected and analyzed with effect sizes calculated. Results, conclusions, and recommendations were carefully poured over with thoughtful next steps organized. As mentioned, previously, the next steps lay the foundation for "Developing the Next Generation of Ag Safety and Health Leaders" in-service training for California's secondary Agricultural Teachers to develop their students for employment in the agriculture industry. The training is slated for July, 2015. The manuscript was submitted to the 2014 American Association for Agricultural Education's Western Region Research Conference. The manuscript was then edited and submitted to the ASABE Journal, which awaiting peer review.

## **Pilot – Assessment of Arizona Agriculture Health Data**

Philip Harber, MD, University of Arizona

The work has included meetings with University and non-university personnel involved in the agricultural sector. In addition, we have met with the representatives of the state Industrial Commission (workers compensation), the statistics division of the Division of Industrial Relations, and the state OSHA. Based upon the input, we are pursuing other ad hoc information sources.

Working with the Arizona Department of Health Services, we have been able to access the Hospital Discharge and death certificate databases. In addition, we have created a computer system to extract information from large databases. This is the necessary because of the data sharing agreement, which precludes looking at any information with fewer than 10 person personnel. The software can serve as an intermediary, doing trial runs to determine if specified queries would lead to any unacceptable level of granularity. Now that this is in place, we will be implementing the data collection using markers such as E codes, diagnoses (ICD-9 or 10), and similar sources. Unfortunately, the hospital discharge database does not include occupation or industry, and so we must indirectly impute the significance of rates for agriculture by comparing disease/injury rates per adult population size in comparison to the significance of the agricultural sector within county.

One of the most relevant accomplishments has been forging a relationship among the University researchers, the state health department, and the industrial relations department. Several other processes are underway. We anticipate having a comprehensive report completed before December of this year. The work has been conducted by a combination of University of Arizona staff, and epidemiology graduate student summer intern, and Kenneth Roach of the state health department.

## APPENDIX C - WCAHS OUTPUTS

### Publications

#### Castañeda, A.R.

Carosino CM, Bein KJ, Plummer LE, **Castañeda AR**, Zhao YJ, Wexler AS, Pinkerton KE. Allergic airway inflammation is differentially exacerbated by daytime and nighttime ultrafine and submicron fine ambient particles: heme oxygenase-1 as an indicator of PM-mediated allergic inflammation. *Journal of Environmental Toxicology*. 2014. In press.

#### Fathallah

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#### Hammock

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\*Center-supported postdoctoral fellow; \*\*Center-supported graduate student.

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### **Schenker**

Trunnell KJ, Bennett DB, Chang KA, **Schenker MB**; Tancredi DJ, Gee SJ, Stoecklin-Marois MT, Hammock BD. Concentrations of the urinary pyrethroid metabolite 3-phenoxybenzoic acid in farm worker families in the MICASA Study. *Environmental Research*. 2014;131:153-159.

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## **Presentations**

### **Castañeda, A. R.**

"Particulate matter enhances pulmonary allergic immune responses." UC Davis T32 Pharmacology Fellowship Retreat. Davis, CA. Sept 22. 2014.

### **Castañeda, X.**

"Occupational health." 9th Summer Institute on Migration and Global Health. Oakland, CA. June 18, 2014.

"Occupational health and accident prevention in farmworkers," Binational *Promotoras* Conference. Oakland, CA. September 9, 2014.

### **Fathallah**

"Practical ergonomics in the packing house." 2013 North American Agricultural Safety Summit. Minneapolis, MN.

"Overview of ergonomic issues in US agriculture." 2013 North American Agricultural Safety Summit. Minneapolis, MN.

"Agricultural ergonomics in California." American University of Beirut Faculty of Health Sciences. December, 2013.

"Highlighting the project to researchers." Tokyo University of Agriculture and Technology. March 2014.

**Leigh**

"Use of Medicaid by documented and undocumented farm workers." Agricultural Health and Safety Seminar. UC Davis. November 4, 2013.

"Use of Medicaid by documented and undocumented farm worker households." UC Davis Health Services. Seminar. UC Davis. November 19, 2013.

"Use of Medicaid by documented and undocumented farm worker households." Graduate epidemiology course. UC Davis. January 13, 2014.

"Medical costs for underserved populations." Dr. Kruse's course on health care to underserved populations. January 28, 2014.

"An estimate of the US government's undercount of occupational injuries on farms." UC Davis Health Services Seminar. UC Davis. September 24, 2014.

**Rainwater**

"Evaluation and outreach." WCAHS Annual Retreat. UC Davis. September 2014.

**Schenker**

"Perspectives from the medical community." Sembrando Salud, Reiter Affiliated Companies. Oxnard, California, September 10, 2013.

"The future of food requires a healthy workforce." California Public Health Association-North Conference. Sacramento, CA. October 2, 2013.

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"Occupational disease." SPH 262. UC Davis. November 4, 2013.

"Migration and occupational health." School of Nursing. UC, San Francisco. November 6, 2013.

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"Inorganic dust exposure in California agriculture," Biological and Agricultural Engineering Seminar. UC Davis. Davis, CA. February 19, 2014.

“An overview of international migration,” SPH 212. UC Davis. Davis, CA. April 1, 2014.

“Health disparities of immigrant workers.” The Division of Community, Environment and Policy Seminar. University of Arizona, College of Public Health. Tucson, AZ. April 2, 2014.

“W17 conducting a disease intervention program with Mexican agricultural workers in California,” European Public Health Association (EUPHA) 5<sup>th</sup> European Conference on Migrant and Ethnic Minority Health. Andalusian School of Public Health. Granada, Spain. April 10-12, 2014.

“A global perspective of migration and occupational health.” Humbio 122M/PEDS 213: Health Challenges of Human Migration. Stanford University. April 23, 2014.

“Occupational Health of Immigrant Workers: Reducing the Disparities,” Guest Speaker, NORA Symposium, University of Minnesota, School of Public Health, Minneapolis, Minnesota, May 1, 2014.

“Infectious disease and occupational health among immigrants.” SPH 212. U C Davis. Davis, CA. May 6, 2014.

“Extreme heat and workers.” 2014 Lela Morris COEH Symposium. Elihu M. Oakland, CA. May 9, 2014.

“Occupational Health.” 9<sup>th</sup> Summer Institute on Migration and Global Health.” Oakland and Berkeley, CA. June 16-18, 2014.

“Challenges in studying immigrants and occupational health.” International EPICOH Conference. Chicago, IL. June 25, 2014.

“The occupational health of migrant workers.” Seminar on Migration, Occupational, and Environmental Health: International Experiences and Perspectives. University of Guadalajara. Mexico. September 3-5, 2014.

## **Abstracts/Other Outputs/Accomplishments**

### **Castañeda, A.R.**

3<sup>rd</sup> Place Poster Presentation at the UC Davis Interdisciplinary Graduate Student Symposium (April 2014)

**Castañeda, A. R. and K. E. Pinkerton.** Particulate matter enhances pulmonary allergic immune responses. Poster session presented at: the Interdisciplinary Graduate Student Symposium; 2014 April 3-4; Davis, CA.

**Castañeda**, A. R. and K. E. Pinkerton. Particulate matter enhances pulmonary allergic immune responses. Poster session presented at: the Fifth Annual UC Davis Lung Day; 2014 May 7; Davis, CA.

**Castañeda**, A. R. and K. E. Pinkerton. Particulate matter enhances pulmonary allergic immune responses. Poster session presented at: the American Thoracic Society; 2014 May 16-21; San Diego, CA

Carratt, S. A., M. Hasan, **A.R. Castañeda**, S. Jetty, J. Peake, I. Griffin, and K.E. Pinkerton. The Effects of Secondhand Smoke Exposure during Pregnancy, Lactation and the Postpartum Period on the Pulmonary Allergenic Immune Response Poster session presented by A.R. Castañeda on behalf of S.A. Carratt at: the American Thoracic Society; 2014 May 16-21; San Diego, CA

**Castañeda**, A. R. and K. E. Pinkerton. Particulate matter enhances pulmonary allergic immune responses. Poster session presented at: UC Davis T32 Pharmacology Fellowship Retreat; 2014 Sept 22; Davis, CA

UC Davis John Muir Institute of the Environment White Family Graduate Student Award Program 2014-2015

### **Fathallah**

Hosted a visiting professor from State University of Campinas (UNICAMP), Brazil, for six months (August 2013-February 2014). The professor was introduced to the ladder project.

### **Hammock**

*Although the work cited below was not directly supported by this grant, the technology that was developed in collaboration with our laboratory is potentially important for delivering immunoassay-based diagnostics to the field via the use of a cell phone.*

Chen, A., R. Wang, C.R.S. Bever, S. Xing, **B.D. Hammock** and T.Pan. 2014. Smartphone-interfaced lab-on-a-chip devices for field-deployable ELISA. Biomicrofluidics, submitted.

### **Rainwater**

Template: "Center-specific Summary Document" (January 2014)

Repository: "National NIOSH Ag Centers Outcomes Documents Repository" (January 2014)

Report: "Results of the Stakeholders' Survey" (WCAHS Annual Retreat, October 2013)

Poster: "WCAHS' significant accomplishments in promoting agricultural health and safety" (NIOSH Ag Center/ERC Directors' Meeting October 2013 in Aurora, CO)

**Schenker**

Study Website for the California Heat Illness Prevention Study:

<http://farmworkerheatillness.ucdavis.edu/>

Blog Post on the research work: September 4, 2014:

<http://westernaghealthandsafety.wordpress.com/2014/09/04/life-of-a-wcahs-student-researcher-heat-illness-study/>